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APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
10/053,446	01/17/2002	Janis Virbulis	VIRBULIS ET AL -1	3544

7590 08/04/2004

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EXAMINER	
SONG, MATTHEW J	

ART UNIT	PAPER NUMBER
1765	

DATE MAILED: 08/04/2004

Please find below and/or attached an Office communication concerning this application or proceeding.

Office Action Summary	Application No.	Applicant(s)
	10/053,446	VIRBULIS ET AL.
	Examiner	Art Unit
	Matthew J Song	1765

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If the period for reply specified above is less than thirty (30) days, a reply within the statutory minimum of thirty (30) days will be considered timely.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133). Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

1)☒ Responsive to communication(s) filed on *20 May 2004*.

2a)☐ This action is **FINAL**. 2b)☒ This action is non-final.

3)☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

Disposition of Claims

4)☒ Claim(s) *1-4 and 14-16* is/are pending in the application.

4a) Of the above claim(s) _____ is/are withdrawn from consideration.

5)☐ Claim(s) _____ is/are allowed.

6)☒ Claim(s) *1-4 and 14-16* is/are rejected.

7)☐ Claim(s) _____ is/are objected to.

8)☐ Claim(s) _____ are subject to restriction and/or election requirement.

Application Papers

9)☐ The specification is objected to by the Examiner.

10)☐ The drawing(s) filed on _____ is/are: a)☐ accepted or b)☐ objected to by the Examiner.

Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).

Replacement drawing sheet(s) including the correction is required if the drawing(s) is objected to. See 37 CFR 1.121(d).

11)☐ The oath or declaration is objected to by the Examiner. Note the attached Office Action or form PTO-152.

Priority under 35 U.S.C. § 119

12)☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).

a)☐ All b)☐ Some * c)☐ None of:

1.☐ Certified copies of the priority documents have been received.

2.☐ Certified copies of the priority documents have been received in Application No. _____.

3.☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).

* See the attached detailed Office action for a list of the certified copies not received.

Attachment(s)

1) ☒ Notice of References Cited (PTO-892)
2) ☐ Notice of Draftsperson's Patent Drawing Review (PTO-948)
3) ☐ Information Disclosure Statement(s) (PTO-1449 or PTO/SB/08) Paper No(s)/Mail Date _____.
4) ☐ Interview Summary (PTO-413) Paper No(s)/Mail Date. _____.
5) ☐ Notice of Informal Patent Application (PTO-152)
6) ☐ Other: _____.

DETAILED ACTION

Continued Examination Under 37 CFR 1.114

1. A request for continued examination under 37 CFR 1.114, including the fee set forth in 37 CFR 1.17(e), was filed in this application after final rejection. Since this application is eligible for continued examination under 37 CFR 1.114, and the fee set forth in 37 CFR 1.17(e) has been timely paid, the finality of the previous Office action has been withdrawn pursuant to 37 CFR 1.114. Applicant's submission filed on 5/20/2004 has been entered.

Claim Rejections - 35 USC § 112

2. The following is a quotation of the first paragraph of 35 U.S.C. 112:

> The specification shall contain a written description of the invention, and of the manner and process of making and using it, in such full, clear, concise, and exact terms as to enable any person skilled in the art to which it pertains, or with which it is most nearly connected, to make and use the same and shall set forth the best mode contemplated by the inventor of carrying out his invention.

3. Claims 1 and 14 are rejected under 35 U.S.C. 112, first paragraph, as failing to comply with the written description requirement. The claim(s) contains subject matter, which was not described in the specification in such a way as to reasonably convey to one skilled in the relevant art that the inventor(s), at the time the application was filed, had possession of the claimed invention. Claim 1 recites, " except for said traveling magnetic field no further magnetic field being applied to the melt" in line 11-12. The instant specification teaches applying a traveling magnetic field and does not show other magnetic field devices, however there is no direct support for the exclusion of other magnetic fields. Any negative limitation or exclusionary

proviso must have basis in the original disclosure and the mere absence of a positive recitation is not basis for an exclusion (MPEP 2173.05 (i)).

Claim Rejections - 35 USC § 103

4. The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

> (a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negatived by the manner in which the invention was made.

This application currently names joint inventors. In considering patentability of the claims under 35 U.S.C. 103(a), the examiner presumes that the subject matter of the various claims was commonly owned at the time any inventions covered therein were made absent any evidence to the contrary. Applicant is advised of the obligation under 37 CFR 1.56 to point out the inventor and invention dates of each claim that was not commonly owned at the time a later invention was made in order for the examiner to consider the applicability of 35 U.S.C. 103(c) and potential 35 U.S.C. 102(e), (f) or (g) prior art under 35 U.S.C. 103(a).

5. Claims 1-3 and 14-16 are rejected under 35 U.S.C. 103(a) as being unpatentable over Tamatsuka et al (US 6,139,625) in view of Luter et al (US 6,053,974) along with Aratani (DE 3701811), an English Abstract has been provided.

Tamatsuka et al discloses 8-inch diameter (203.2 mm) silicon single crystal ingots were pulled by the Czochralski method with an oxygen concentration of $0.7x10^{18}$ atoms/cm^3 or more

(Table 1) from a silicon melt in a quartz crucible with a diameter of 18 inches (457.2 mm) (col 8, ln 1 to col 9, ln 65).

Tamatsuka et al does not disclose a heat shield above the crucible.

In a method of forming a single crystal by the Czochralski method, note entire reference, Luter et al teaches a heat shield **40** mounted above the surface of a molten source material for growing ingots with a diameter of about 220 mm (Fig 1, col 4, ln 1-67 and col 5, ln 1-15). Luter et al also teaches the overall gradient at the surface is reduced which reduces the number of defects at the surface and the distribution of defects is more even throughout the ingot for ingots produced with the heat shield (col 7, ln 1-15). It would have been obvious to a person of ordinary skill in the art at the time of the invention to modify Tamatsuka et al with Luter et al's heat shield to reduce defects in the ingot.

The combination of Tamatsuka et al and Luter et al is silent to exposing the silicon melt to an influence of a traveling magnetic filed which exerts a substantially vertically orientated force on the melt in a region of the crucible wall.

In a method of producing a single crystal using the Czochralski method, Aratani teaches applying a downwardly traveling magnetic field to the melt in the crucible, this reads on applicants' vertically oriented force. Aratani also discloses a single magnetic field application device **8**, note Figure 1, this reads on applicants' except for the traveling magnetic field no further magnetic field being applied to the melt.

Travelling magnetic field are known in the art to be advantageous in minimizing dissolution of oxygen from the silica material of a crucible and for stirring a melt in Czochralski processes, as evidenced by Aratani (DE 3701733) and Szekely et al (US 5,196,085) below.

Therefore, it would have been obvious to a person of ordinary skill in the art at the time of the invention to modify the combination of Tamatsuka et al and Luter et al by applying a traveling magnetic field, as taught by Aratani to minimize dissolution of oxygen from the silica of the crucible and for stirring the melt, which is desirable.

Referring to claim 1, the combination of Tamatsuka et al, Luter et al, and Aratani teach pulling a silicon ingot with a diameter of 8 inches from a 18 inch crucible, a heat shield for reducing defects and vertical magnetic field to eliminate flow instabilities.

Referring to claim 2, the combination of Tamatsuka et al, Luter et al, and Aratani teach oxygen concentrations of $0.7x10^{18}$ atoms/cm^3 or more

Referring to claim 3, the combination of Tamatsuka et al, Luter et al, and Aratani teaches the magnetic filed with an axial downward direction applied selectively at the growing crystal surface vicinity.

Referring to claims 14 and 16, the combination of Tamatsuka et al, Luter et al and Aratani teach all of the limitations of claim 14, except the traveling magnetic is due to three coils which are connected to a 3-phase power supply and the traveling magnetic field exerts a substantially vertically oriented force on the melt is generated by suitable selection of an order of connections; and the connections of the coils have a phase angle in an order of 0°-60°-120° or 0°-120°-240°. The combination of Tamatsuka et al, Luter et al and Aratani teaches providing a traveling magnetic field but is silent to the means of producing the magnetic field. It would have been obvious to a person of ordinary skill in the art at the time of the invention to modify Tamatsuka et al, Luter et al and Aratani by using a magnetic field generator with three coils connected to a 3 phase power supply and a phase angle in an order of 0°-120°-240° because it is

conventionally used to produce a traveling magnetic field, note Ou-Yang et al (US 6,636,037), Crowley et al (US 4,808,079), Lari et al (US 4,905,756) and Morishita et al (JP 61-029128).

Referring to claim 15, the combination of Tamatsuka et al, Luter et al, and Aratani teaches exposing a silicon melt to a traveling magnetic field, which exerts a vertically oriented force on the melt. The combination of Tamatsuka et al, Luter et al, and Aratani does not teach applying the traveling magnetic field to produce attenuation of low frequency temperature fluctuations. The fact that applicant has recognized another advantage which would flow naturally from following the suggestion of the prior art cannot be the basis for patentability when the differences would otherwise be obvious. See *Ex parte Obiaya*, 227 USPQ 58, 60 (Bd. Pat. App. & Inter. 1985). The use of the traveling magnetic field inherently produces attenuations of low frequency temperature fluctuations, as evidenced page 10 of the applicants' disclosure.

6. Claim 4 is rejected under 35 U.S.C. 103(a) as being unpatentable over Tamatsuka et al (US 6,139,625) in view of Luter et al (US 6,053,974) along with Aratani (DE 3701811), an English Abstract has been provided, as applied to claims 1-3 above, and further in view of Szekely et al (US 5,196,085).

The combination of Tamatsuka et al, Luter et al and Aratani teach all of the limitations of claim 4, as discussed previously, except a traveling magnetic field primarily directed vertically upward.

In a method of controlling the flow in Czochralski (CZ) systems, note entire reference, Szekely et al teaches a CZ growing system with an axial magnetic filed in the vicinity of the melt-crystal interface and melt stirring can be accomplished magnetically by inducing vertical

motion with a traveling field. Szekely et al also teaches controlling the flow in the bulk and in the vicinity of the wells (col 2, ln 1-60). Szekely et al also teaches the magnetic filed with an axial upward or downward direction applied selectively at the growing crystal surface vicinity in combination (col 3, ln 10-62), this a teaching that vertically upward and downward directions are equivalents. Szekely et al also teaches vertical magnetic fields are useful for stabilizing flow (col 1, ln 5-62). It would have been obvious to a person of ordinary skill in the art at the time of the invention to modify combination of Tamatsuka et al, Luter et al and Aratani with Szekely et al's vertically upward magnetic field because substitution of known equivalents is held to be obvious (MPEP 2144.06).

7. Claims 14 and 16 are rejected under 35 U.S.C. 103(a) as being unpatentable over Tamatsuka et al (US 6,139,625) in view of Luter et al (US 6,053,974) along with Aratani (DE 3701811), an English Abstract has been provided, as applied to claims 1-3 above, and further in view of Lari et al.(US 4,905,756) or Morishita et al (JP 61-029128), an English Abstract has been provided.

The combination of Tamatsuka et al, Luter et al and Aratani teach all of the limitations of claim 14, except the traveling magnetic is due to three coils which are connected to a 3-phase power supply and the traveling magnetic field exerts a substantially vertically oriented force on the melt is generated by suitable selection of an order of connections; and the connections of the coils have a phase angle in an order of 0°-60°-120° or 0°-120°-240°. The combination of Tamatsuka et al, Luter et al and Aratani teaches providing a traveling magnetic field but is silent to the means of producing the magnetic field

In an apparatus for producing magnetic fields, note entire reference, Lari et al teaches a magnetic field traveling wave is produced with only two coil layers with current 180° out of phase and in the preferred embodiment, three coil layers 120° out of phase are used, this reads on applicant connections of the coils have a phase angle in an order of 0°-120°-240°. Lari et al also teaches an AC source supplies three-phase alternating current. Also, additional coil waves could de used to produce a traveling wave, for example four coils 90° out of phase. It would have been obvious to a person of ordinary skill in the art at the time of the invention to modify the combination of Tamatsuka et al, Luter et al and Aratani with Lari et al's means of producing a traveling magnetic field because selection of a known material based on its suitability for its intended use is held to be obvious (MPEP 2144.07).

In an apparatus for providing a magnetic field, Morishita et al teaches a magnetic generator made of a coil **30**, which is formed of coils 31a, 31b 31c. And when a 3-phase AC current having 120° different positions are respectively flowed to the coils, a traveling magnetic field which moves in a prescribed direction is generated (Abstract), this reads on applicant connection of the coils have a phase angle in an order of 0°-120°-240°. It would have been obvious to a person of ordinary skill in the art at the time of the invention to modify the combination of Tamatsuka et al, Luter et al and Aratani with Morishita et al's means of producing a traveling magnetic field because selection of a known material based on its suitability for its intended use is held to be obvious (MPEP 2144.07).

Response to Arguments

8. Applicant's arguments, see page 14 of the remarks, filed 5/20/2004, with respect to claims 1-4 and 14 regarding Szekely et al (US 5,196,085) have been fully considered and are persuasive. The rejection of claims 1-4 and 14 has been withdrawn.

9. Applicant's arguments with respect to claims 1-4 and 14-16 have been considered but are moot in view of the new ground(s) of rejection.

10. Applicant's arguments filed 5/20/2004 have been fully considered but they are not persuasive.

In response to applicant's argument that Lari et al, Crowley, Morishita and Ou Yang are nonanalogous art, it has been held that a prior art reference must either be in the field of applicant's endeavor or, if not, then be reasonably pertinent to the particular problem with which the applicant was concerned, in order to be relied upon as a basis for rejection of the claimed invention. See *In re Oetiker*, 977 F.2d 1443, 24 USPQ2d 1443 (Fed. Cir. 1992). In this case, the prior art references are in the field of producing traveling magnetic field; therefore are analogous art.

Conclusion

11. The prior art made of record and not relied upon is considered pertinent to applicant's disclosure.

Aratani (DE 3701733) teaches applying a traveling magnetic field to a melt in a Czochralski process minimizes dissolution of oxygen from silica material of a crucible (Abstract).

Szekely et al (US 5,196,085) teaches a CZ growing system with an axial magnetic filed in the vicinity of the melt-crystal interface and melt stirring can be accomplished magnetically by inducing vertical motion with a traveling field (col 2, ln 1-67) and vertical magnetic fields are useful for stabilizing flow (col 1, ln 5-62).

Wilson et al (US 6,284,384) teaches $5x10^{17}$ atoms per cm^3 is equivalent to 10 oxygen atoms per million total atoms in the wafer (col 8, ln 64 to col 9, ln 15).

Nanaka (JP 62-070286) teaches a magnetic field directed downward (Fig 1) and a magnetic field directed upward (Fig 4), note abstract.

Iida et al (US 6,077,343) teaches a Czochralski method employing a heat shield and a magnetic field (col 10, ln 1-67).

Kawanishi et al (US 6,086,671) teaches a magnetic field directed upward a crucible wall (col 3, ln 1-67).

Crowley et al (US 4,808,079) teaches at least two coils which are electrically connected to a three-phase power source is used to produce a traveling magnetic field (col 2, ln 25-35 and col 3, ln 1-20).

Ou-Yang (US 6,636,037) teaches a traveling magnetic field is provided by three coils driven by a phase that is 120° offset from the last phase signal (col 7, ln 1-50).

12. Any inquiry concerning this communication or earlier communications from the examiner should be directed to Matthew J Song whose telephone number is 571-272-1468. The examiner can normally be reached on M-F 9:00-5:00.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Nadine Norton can be reached on 571-272-1465. The fax phone number for the organization where this application or proceeding is assigned is 703-872-9306.

Information regarding the status of an application may be obtained from the Patent Application Information Retrieval (PAIR) system. Status information for published applications may be obtained from either Private PAIR or Public PAIR. Status information for unpublished applications is available through Private PAIR only. For more information about the PAIR system, see http://pair-direct.uspto.gov. Should you have questions on access to the Private PAIR system, contact the Electronic Business Center (EBC) at 866-217-9197 (toll-free).

Matthew J Song
Examiner
Art Unit 1765

MJS

NADINE G. NORTON
SUPERVISORY PATENT EXAMINER